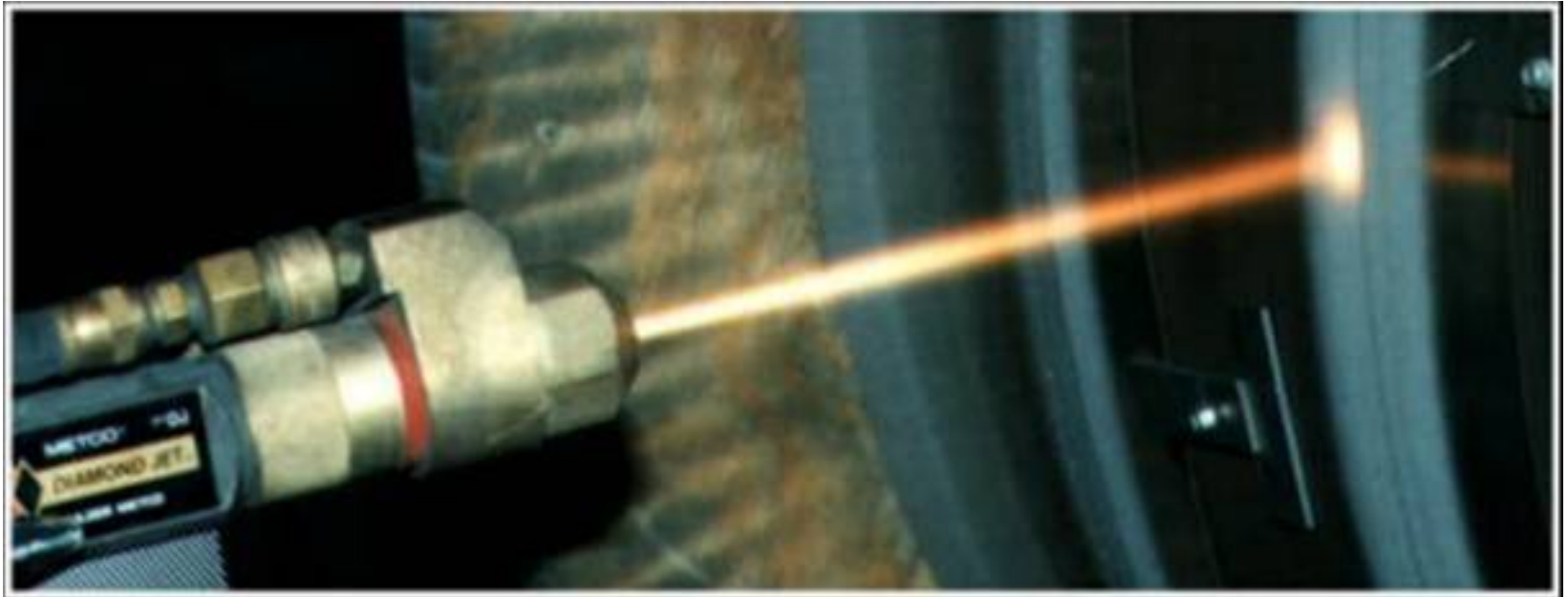


Hard Chrome Alternatives for Hydraulic Components



Matt Reynolds
ARINC
Oklahoma City, OK
405-605-7086
mreynold@arinc.com



Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE JAN 2006		2. REPORT TYPE		3. DATES COVERED 00-00-2006 to 00-00-2006	
4. TITLE AND SUBTITLE Hard Chrome Alternatives for Hydraulic Components				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) ARINC,2551 Riva Rd,Annapolis,MD,21401				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES 26th Replacement of Hard Chrome and Cadmium Plating Program Review Meeting, January 24-26, 2006, San Diego, CA. Sponsored by SERDP/ESTCP.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 21	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Hard Chrome Alternatives for Hydraulic Components

- Program established to assist Oklahoma City Air logistics Center Airborne Accessories Directorate Avionics and Accessories Division (448 ACSG/ENWF, formerly OC-ALC/LGERC) in development and implementation of replacement, repair, and overhaul procedures for hydraulic actuators across multiple weapon systems.



Hard Chrome Alternatives for Hydraulic Components

- Phase 1 – TO and Drawing Review, Database Development, Test Requirement Development
- Phase 2 – Delta-Qualification and Service Testing
- Phase 3 – Data Evaluation
- Phase 4 - Implementation



Hard Chrome Alternatives for Hydraulic Components

- Phase 1 – TO and Drawing Review, Database Development, Test Requirement Development
 - 100% Complete
 - 124 Air Force Technical Orders Reviewed.
 - 729 Engineering Drawings Reviewed.
 - 276 Chrome plated parts and 195 potentially chrome plated parts have been identified



Hard Chrome Alternatives for Hydraulic Components

- Phase 2 – Delta-Qualification and Service Testing
 - Delta-Qualification Testing
 - Flight Control Actuators
 - 87 distinct part numbers
 - 10 estimated to require delta-qualification
 - Utility Actuators
 - 73 distinct part numbers
 - 10 estimated to require delta-qualification
 - Snubbers/Other
 - 12 distinct part numbers
 - 3 estimated to require delta-qualification



Hard Chrome Alternatives for Hydraulic Components

- Rig Testing
 - Completed
 - C-130 rudder actuator
 - C-130 ramp cylinder
 - KC-135 main landing gear actuator
 - KC-135 aileron snubber
 - A-10 aileron actuator
 - B-1 horizontal stab actuator
 - T-38 aileron actuator (testing completed, report in review)
 - In progress
 - F-15 Pitch/Roll Channel Assembly (PRCA)
 - KC-135 Ruddevator (additional seal options)



Hard Chrome Alternatives for Hydraulic Components

- Service Testing
 - In preparation / progress
 - C/KC-135
 - C-130
 - Test plan approved through AMC, SPOs
 - Single test plan for both platforms
 - Two year plan, with mid term option to terminate
 - In planning / negotiation with SPOs, using commands
 - A-10
 - T-38



Hard Chrome Alternatives for Hydraulic Components

- Service Testing (cont)
 - C/KC-135 Service Test to include
 - Snubbers (2 units)
 - Main Landing Gear Actuator (2 units)
 - Main Landing Gear Door Actuator (2 units)
 - Ruddevator Actuator (2 units)
 - Installation planned for Feb 06 at Grand Forks and MacDill AFBs



Hard Chrome Alternatives for Hydraulic Components

- C/KC-135 Aileron Snubber

- Endurance Testing Results

- Actuator C, with O-ring and back-ups, completed 21,200 cycles with zero leakage
 - Actuator D, with VL Seal (S), completed 21,200 cycles with 8 total drops of fluid.
 - This piston rod had small circumferential scratch at test completion.



Hard Chrome Alternatives for Hydraulic Components

- C/KC-135 Main Landing Gear Actuator
 - Used to extend and retract the C/KC-135 MLG
 - Rig test included 20,000 cycles, high and low temp



Hard Chrome Alternatives for Hydraulic Components

- C/KC-135 Main Landing Gear Door Actuator
 - Used to open and close the C/KC-135 MLG Door
 - Similarity arguments in lieu of rig testing



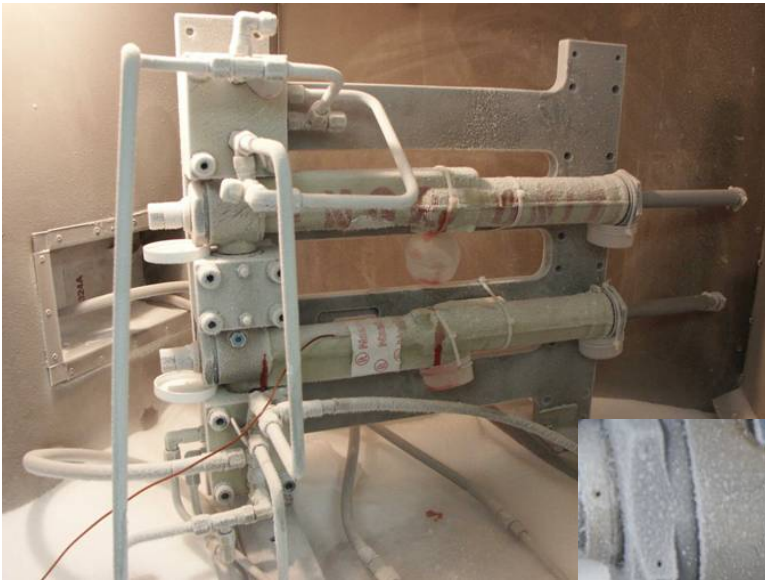
Hard Chrome Alternatives for Hydraulic Components

- Service Testing (cont)
 - C-130 Service Test to include:
 - Rudder Actuator (1 unit)
 - Aileron Actuator (1 unit)
 - Elevator Actuator (2 units)
 - Ramp Actuator (2 units)
 - Aft Cargo Door Actuator (2 units)
 - Components of these actuators are being coating and finished.
 - Assembly into actuators planned for Feb/Mar 06
 - Installation planned for Mar 06 at Little Rock AFB and Delaware ANG.



Hard Chrome Alternatives for Hydraulic Components

- C-130 Rudder Cylinder in Cold Test
 - Early leakage determined to be due to gland OD seals
 - Similarity arguments applied to aileron and elevator actuators in lieu of rig testing



Hard Chrome Alternatives for Hydraulic Components

- C-130 Ramp Actuator
 - Used to operate the C-130 Ramp Door
 - Rig test included 20,000 cycles, high and low temp
 - Similarity argument applied to aft cargo door in lieu of rig testing



\$



Hard Chrome Alternatives for Hydraulic Components

- B-1 Horizontal Stabilizer
 - Drives horizontal stab surfaces for pitch and roll control
 - USAF contract to Boeing



Hard Chrome Alternatives for Hydraulic Components

- B-1 Horizontal Stabilizer
 - Coating
 - Forward Piston coated by Southwest United Industries
 - Aft Piston coated by PTI



Hard Chrome Alternatives for Hydraulic Components

- B-1 Horizontal Stabilizer
 - Rig Testing
 - Performed by Boeing
 - Endurance – 750,000 (approx 1/2 aircraft life)
 - No unacceptable leakage observed
 - Service Tests - None
 - Similarity Arguments
 - Other B-1 flight control actuators
 - Drawing updates completed
 - TO and stocklist updates in progress



Hard Chrome Alternatives for Hydraulic Components

- B-1 Pitch/Roll SCAS
 - Provides pitch and roll input to mixers and on to horizontal stab surfaces for added stability and for autoflight
- USAF contract to Boeing
- Simplified endurance scan to qualify
- Test in progress



Hard Chrome Alternatives for Hydraulic Components

- Phase 4 – Implementation
 - B-1 horizontal stab drawings updated, TOs under review by 448 ACSG/ENWF (formerly OC-ALC/LGERC) to prepare for implementation at overhaul
 - Component repair drawings in preparation for other projects (ARINC and 448 ACSG/ENWF)
 - Implementation strategy under discussion with AF internal Technical Review Boards (TRBs), OEMs, SPOs (e.g., configuration issues, part numbers, etc.)



Hard Chrome Alternatives for Hydraulic Components

- Summary
 - 1 Actuator (B-1 Horizontal Stab) has completed qualification testing and is ready for implementation.
 - 6 Actuators (C/KC-135 Aileron Snubber, A-10 Aileron, C/KC-135 MLG, C-130 Rudder Booster, T-38 Aileron and C-130 Ramp Cylinder) have successfully completed rig testing.
 - 4 C/KC-135 Actuators (MLG, MLG Door, Aileron Snubber, Ruddevator) are ready for installation on the C/KC-135 for service testing.
 - 5 C-130 Actuators (Ramp Cylinder, Aft Cargo Door Cylinder, Elevator Booster, Aileron Booster, and Rudder Booster) being prepared for installation on the C-130 for service testing.
 - 2 Actuators (KC-135 Ruddevator, F-15 PRCA) are on contract for rig testing
 - Numerous additional actuators will be considered for similarity pending successful completion of rig and service testing described above.



Hard Chrome Alternatives for Hydraulic Components

- Questions?

